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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

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(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
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Frozen aerated product

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Frozen Aerated Product

Technical field of the invention

The present invention relates to a frozen aerated product such as an ice cream. It more particularly relates to a frozen aerated product in the form of a log. It particularly relates to frozen aerated products produced by extruding a soft formulation.

Background of the invention

Frozen aerated products are normally produced using a scraped surface heat exchanger (SSHE). The products manufactured using such equipment must be stable at the temperature at which they are produced, namely around -6 to -10C. By stable it is meant that the product must be rigid enough to sustain its own weight until and when the product is directed towards a hardening tunnel wherein the product is typically brought down to a temperature of -20°C. During this hardening step, the ice cream product typically moves from an ice content of around 30% (at the exit of the SSHE) to an ice content of at least 45%.

Certain formulations are too soft to allow for a product like a log to be produce by extrusion at the exit of a SSHE. There is a need for producing an extruded log-shaped frozen aerated product with a formulation which is such that the product cannot sustain its shape under standard manufacturing conditions.

It has now been found that it is possible to produce log-shaped frozen aerated products which were not possible to produce before by carefully choosing the processing conditions.

Tests and definitions

Ice Content

Ice content is measured by adiabatic calorimetry as described by de Cindio and Correra in the Journal of Food Engineering (1995) 24 pp.405-415. More specifically this was described for complex ice cream analysis by Jarvis, D.at the Inter-Ice Conference (1999) in Solingen, Germany.

Overrun

Overrun is defined by the following equation

$$OR = \frac{volume..of..ice..cream - volume..of..mix..at..ambient..temp}{volume..of..mix..at..ambient..temp} \times 100$$

It is measured at atmospheric pressure.

Log-shaped

By log shaped it is meant any product having a generally constant cross section. The cross-section may be generally rectangular, triangular, circular or lenticular. Log shaped product are typically produced by extrusion.

Aspect ratio

The aspect ratio is defined as the ratio of the height of the cross section of the log to its width.

Stabilisers

Any of the list of biopolymers typically used in ice cream at levels for thickening but not forming a supporting gel network at extrusion. Preferably, stabilisers used in the present invention are selected from the group consisting of alginates, guar gum, xanthan gum, locust bean gum, gum arabic, gum karaya, gum

tragacanth, tara gum, oat gum, furcellaran, carrageenans, gelatine, agar, sodium carboxymethylcellulose, microcrystalline cellulose, methyl cellulosics, low and high methoxy pectins and mixtures thereof.

Emulsifiers and Aerating Agents

Emulsifiers and aerating agents (in non-fat systems) included are those typically used in ice-cream manufacture (defined as in Ice Cream 6th Edition, Marshall et al. (2003), pp.85-86).

Total Solids

The dry weight of the system as measured using the oven drying method as described in Ice Cream 6th Edition, Marshall et al. (2003), p.296.

Fat Content

The fat used may be a dairy fat, a non-dairy fat or a mixture of both. When the fat is a dairy fat, it may be any milk fat source such as butter oil, butter, cream or a mixture thereof. A non-dairy fat is an edible oil or fat, preferably a vegetable oil such as palm oil, coconut oil or mixtures thereof, or an hydrogenated fat. Fat content can be measured by methods described in Pearsons Chemical Analysis of foods, 1991, 8th edition, pp502.

Milk-Solids Non-Fat

The milk solids non-fat (MSNF) contains milk proteins and lactose. MSNF may be provided by using dried milk, liquid milk or concentrated milk products and typical examples include dried whole milk, dried skimmed milk, dried whey, liquid milk, concentrated milk products and mixtures thereof.

Freezing Point Depressants

Sugars and sugar alcohols can be used to depress the freezing point and manipulate the ice content of the product on extrusion. Sugars typically included are sucrose, fructose, glucose, lactose, dextrose, invert sugar and corn sugars or mixtures thereof which can be included in either a crystalline or liquid form. Mono- and disaccharide sugar alcohols such as sorbitol, mannitol, xylitol, erythritol, lactitol, maltitol, isomalt and related starch hydrolysates can also be used as a full or partial replacement to the sugars for the purpose of freezing point manipulation.

Fruit Content

In Europe, the industry accepted guidelines recommend that sorbets contain a minimum fruit content of 25%, or 15% for citrus and exotic fruits (see Sorbets et Cremes Glaces, Code Euroglaces, Syndicat des Fabricants Industriel de Glaces). This fruit is included usually in the form of a fruit juice or "puree". The latter meaning an homogeneous product prepared from whole or peeled fruit of good maturity which has been pulped by a suitable physical process (see Revised Draft Codex General Standard for Fruit Juices and Nectars, National Juice Product Association 2001). The puree and juices may or may not have had a portion of the water physically removed and optionally sugars added. The fruit purees or juices contain dietary fibre (soluble and insoluble) which is defined as food material particularly plant material that is not hydrolysed by enzymes secreted by the human digestive tract but that may be digested by microflora in the gut. The total fruit equivalent can be calculated from the measured amount of dietary fibre ("Total, soluble and insoluble dietary fibre in foods", AOAC International (1995), Method 991.43, Official Methods of

Analysis, 16th Edition). The dietary fibre may be derived from fruits or vegetables from one or more fruit puree or juice, one or more vegetable purees or mixtures thereof and additionally from added celluloses, hemicelluloses, pectic substances, gums, mucilages, lignins and modified polysaccharides such as carboxymethylcellulose.

Brief description of the invention

It is the object of the invention to provide a frozen aerated product containing less than 4.5% w/w fat, having an overrun of between 30% and 120% and an ice content of between 30% and 55% at a temperature of -18°C.

Preferably the frozen aerated product of the invention is log shaped.

More preferably, the log-shaped frozen aerated product is at least 4cm high.

Even more preferably the log-shaped frozen aerated product has an aspect ratio of between 0.8:1 and 2:1, preferably between 0.8:1 and 1.5:1.

Preferably also, the frozen aerated product according to the invention contains less than 1% w/w stabiliser.

Preferably also, the frozen aerated product has a total solids content of between 25 and 50% (w/w).

Detailed description of the invention

The present invention will be further described with reference to the following examples.

Sorbet Examples:

Various sorbet formulations were produced as described in Table 1.

Table 1: Extruded Sorbet Formulations

Example	1	2	3	4	5	6	7	8
Product	Sorbet	Sorbet	Sorbet	Sorbet	Sorbet	Sorbet	Sorbet	Sorbet
Formulation								
Dextrose	17	14	4	8	16	10	3	3
Sucrose	19.5	16	16	9.9	23.5	23	23	17
Glucose Syrup DE63	6.5	6.6	6	5.5	5	5	5	5
Strawberry Puree	30	30	30	30	0	0	0	0
Lemon Juice Conc x4	0	0	0	0	5	5	5	5
Emulsifier	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
LBG	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Guar	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Water	26.3	32.7	43.3	45.9	49.8	56.3	63.3	69.3
Properties								
Total Solids	44	38	33	25	44	39	32	26
Total Fat	0	0	0	0	0	0	0	0
Total Sugars	42	36	31	23	46	39	32	26
Ice at -18C	30	40	50	60	30	40	50	60
Overrun %	60-100	60-100	60-100	60-100	60-100	60-100	60-100	60-100

Examples 1 to 8 were extruded at maximal freezing conditions through a SSHE (Crepaco W04 freezer, series 80 dasher, 150-250 L/hr mix and motor load 80-90%) to assess the possibility of producing a continuous and defined extrusion. This was then also extruded at colder exit temperatures (see below) through a continuous single screw coldextrusion equipment as described in WO98/09536 at a mix throughput of 150-250L/hr.

The acceptability of the extrusion was assessed after blast hardening (-35°C for 3hours) with a dimensional limit required within 10% of the nozzle dimension. However, these changes were mostly visually obvious on extrusion from the appearance of surface melting and slumping and even total collapse of the extrusion.

Table 2: Comparative extrusion quality of the sorbet formulations.

Example	SSHE Extrusion Temp (°C)	SSHE Extrusion Quality	Cold Extrusion Temp (°C)	Cold Extrusior Quality
1	-14	Not Acceptable	-23	Acceptable
2	-10	Not Acceptable	-20	Acceptable
3	-8	Not Acceptable	-19	Acceptable
4	-8	Acceptable	-17	Acceptable
5	-13	Not Acceptable	-24	Acceptable
6	-10	Not Acceptable	-20	Acceptable
7	-8	Not Acceptable	-19	Acceptable
8	-7	Acceptable	-18	Acceptable

Sherbet / Low Fat Ice Cream Examples:

Various sherbet formulations (4% fat ice cream) were also produced.

Table 2: Extruded Low Fat Ice Cream Formulations

Example Product	9 Sherbet	10 Sherbet	11 Sherbet	12 Sherbet
Formulation				
Coconut Oil	4	4	4	4
Skim Milk Powder	4	4	4	4
Sucrose	25	21	15	11
Glucose Syrup DE63	11	8	8	4
Strawberry Puree	40	40	40	40
Lemon Juice	0	0	0	0
MGP	0.33	0.33	0.33	0.33
LBG	0.15	0.15	0.15	0.15
Guar	0.07	0.07	0.07	0.07
Water	15.45	22.45	28.45	36.45
Properties				
Total Solids	47	40	34	27
Total Fat	4.4	4.4	4.4	4.4
Total Sugars	37	30	24	17
Ice at -18C	30	40	50	60
Overrun %	60-100	60-100	60-100	60-100

Examples 9 to 12 were also extruded at maximal freezing conditions through a SSHE (Crepaco W04 freezer, 150-250 L/hr mix, series 80 dasher and motor load 80-90%) to assess the possibility of producing a continuous and defined extrusion.

This was also extruded at colder exit temperatures (see below) through the continuous cold extrusion equipment at a throughput of 150-250L/hr. As for the sorbets, the extrusion quality was assessed dimensionally.

Table 4: Comparative extrusion quality for sherbet formulations

Example	SSHE Extrusion Temp (°C)	SSHE Extrusion Quality	Cold Extrusion Temp (°C)	Cold Extrusion Quality
9	-10	Not Acceptable	-19	Acceptable
10	-9	Not Acceptable	-18	Acceptable
11	-8	Not Acceptable	-15	Acceptable
12	-5	Acceptable	-8	Acceptable

Shape Stability

Examples 13 to 15 were extruded under maximal conditions from the SSHE (Crepaco W04 freezer, 150 L/hr mix, motor load 80-90%, extrusion temperature -5 to-10°C) through dies with different cross sections.

Table 5: Sorbet formulations to test shape stability on extrusion.

Example Product	13 Sorbet	14 Sorbet	15 Sorbet
Formulation			
Dextrose	9	3	3
Sucrose	22	22	15
Glucose Syrup DE63	5	5	5
Orange Juice Conc	5	5	5
Whipping Aid	0.2	0.2	0.2
LBG	0.3	0.3	0.3
Guar	0.2	0.2	0.2
Water	58.3	64.3	71.3
Properties			
Total Solids	38	33	26
Total Fat	0	0	0
Total Sugars	36	31	23
Ice at -18C	40	50	60
Overrun %	30-80	30-80	30-80

The results are summarised in the following table with a dimensional assessment of whether the extrusion from the SSHE was within 10% of the nozzle dimensions after blast hardening.

Table 6: Acceptability of extrusion quality post SSHE extrusion

Example	Ice Content %	Aspect Ratio						
		0.28	0.45	0.65	0.88	1.14	1.54	2.18
13	40	Yes	Yes	Yes	No	No	No	No
14	50	Yes	Yes	Yes	No	No	No	No
15	60	Yes	Yes	Yes	Yes	Yes	Yes	Yes

For the samples where the extrusion was not acceptable (marked "No") the formulations were also processed through cold extrusion equipment to ensure that they could be extruded within the dimensional constraints of the nozzles. In all cases this was successfully achieved with extrusion temperatures ranging from -8°C to -14°C.

Claims

1. Frozen aerated product containing less than 4.5% w/w fat, having an overrun of between 30% and 120% and an ice content of between 30% and 55%.

2. Frozen aerated product according to claim1 characterised in that it is log shaped.

3. Frozen aerated product according to claim 2 characterised in that it is at least 4cm high.

4. Frozen aerated product according to claim 3 characterised in that it has an aspect ratio of between 0.8:1 and 2:1.

Abstract

A self-sustaining log shaped frozen aerated product is produced by cold-extruding a low fat formulation at a temperature between -15°C and -24°C in order to achieve an ice content at -18°C of between 30% and 55%.